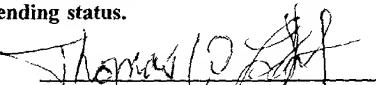


U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE (REV. 9-2001)		ATTORNEY'S DOCKET NUMBER 118.010US01 U.S. APPLICATION NO. (If known, see 37 CFR 1.5 09/990267
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		
INTERNATIONAL APPLICATION NO. PCT/IT00/00229	INTERNATIONAL FILING DATE June 5, 2000	PRIORITY DATE CLAIMED June 3, 1999
TITLE OF INVENTION UNDERWATER BATTERIES PROVIDED WITH LIQUID SEPARATING MEANS BETWEEN INTERNAL ELECTROCHEMICAL ENVIRONMENT AND EXTERNAL...		
APPLICANT(S) FOR DO/EO/US Fernando ZOCCHI		
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:		
<p>1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.</p> <p>4. <input type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31).</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))</p> <ul style="list-style-type: none"> a. <input type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau). b. <input checked="" type="checkbox"/> has been communicated by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US). <p>6. <input type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).</p> <ul style="list-style-type: none"> a. <input type="checkbox"/> is attached hereto. b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4). <p>7. <input type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))</p> <ul style="list-style-type: none"> a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau). b. <input type="checkbox"/> have been communicated by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input type="checkbox"/> have not been made and will not be made. <p>8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</p> <p>10. <input type="checkbox"/> An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p>		
<p>Items 11 to 20 below concern document(s) or information included:</p> <p>11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</p> <p>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>13. <input checked="" type="checkbox"/> A FIRST preliminary amendment. Marked-up Copy of Claims</p> <p>14. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.</p> <p>15. <input type="checkbox"/> A substitute specification.</p> <p>16. <input type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.</p> <p>18. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4).</p> <p>19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).</p> <p>20. <input checked="" type="checkbox"/> Other items or information: Unsigned Declaration/Power of Attorney; Courtesy Copy of PCT published application and IPER in PCT/IT00/00229</p>		

U.S. APPLICATION NO. (If known) 37 CFR 1.492(e)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER		
Unknown 09/980257	PCT/US00/00229	118-0100US01		
<p>21. <input checked="" type="checkbox"/> The following fees are submitted:</p> <p>BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):</p> <p>Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO \$1040.00</p> <p>International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$890.00</p> <p>International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$740.00</p> <p>International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$710.00</p> <p>International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00</p> <p>ENTER APPROPRIATE BASIC FEE AMOUNT =</p>		CALCULATIONS PTO USE ONLY		
		\$ 890.00		
<p>Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input checked="" type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).</p>		\$ 130.00		
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	\$
Total claims	9 - 20 =	0	x \$18.00	\$
Independent claims	1 - 3 =	0	x \$84.00	\$
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ \$280.00	\$ 280.00
				\$ 1300.00
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.			+ \$	
			SUBTOTAL =	\$ 1300.00
<p>Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).</p>			\$	
			TOTAL NATIONAL FEE =	\$ 1300.00
<p>Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property</p>			+ \$	
			TOTAL FEES ENCLOSED =	\$ 1300.00
			Amount to be refunded:	\$
			charged:	\$
<p>a. <input checked="" type="checkbox"/> A check in the amount of \$ 1300.00 to cover the above fees is enclosed.</p> <p>b. <input type="checkbox"/> Please charge my Deposit Account No. _____ in the amount of \$ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.</p> <p>c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 501373. A duplicate copy of this sheet is enclosed.</p> <p>d. <input type="checkbox"/> Fees are to be charged to a credit card. WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.</p>				
<p>NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.</p>				
<p>SEND ALL CORRESPONDENCE TO:</p> <p>Fogg, Slifer & Polglaze, P.A. P.O. Box 581009 Minneapolis, MN 55458-1009</p>				
<p> SIGNATURE</p> <p>Thomas W. Leffert NAME</p> <p>40-697 REGISTRATION NUMBER</p>				

09/980267

JC03 Res'd PCT/TT 30 NOV 2001

Applicant(s)	Fernando Zocchi
Serial No.	Unknown
Filing Date	Herewith
Group Art Unit	Unknown
Examiner Name	Unknown
Attorney Docket No.	118.010US01

PRELIMINARY
AMENDMENT

Title: UNDERWATER BATTERIES PROVIDED WITH LIQUID SEPARATING MEANS
BETWEEN INTERNAL ELECTROCHEMICAL ENVIRONMENT AND EXTERNAL LIQUID
ENVIRONMENT

Commissioner for Patents
Box Patent Application
Washington, D.C. 20231

Before taking up the above-identified patent application for examination, please amend it as follows.

IN THE CLAIMS

Please rewrite claims 4-5 and add new claims 6-9, as provided below.

4. (Once amended) The battery according to claim 1 or 2, wherein insulated and liquid-tight thorough-leads for connecting said battery to an electric load or to a battery recharger are provided.

5. (Once amended) The battery according to claim 1 or 2, wherein said elements or cell units are of the lead/sulphuric acid type.

6. (New) The battery according to claim 3, wherein insulated and liquid-tight thorough-leads for connecting said battery to an electric load or to a battery recharger are provided.

7. (New) The battery according to claim 3, wherein said elements or cell units are of the lead/sulphuric acid type.

8. (New) The battery according to claim 4, wherein said elements or cell units are of the lead/sulphuric acid type.

9. (New) The battery according to claim 6, wherein said elements or cell units are of the lead/sulphuric acid type.

PRELIMINARY AMENDMENT

Serial No. Unknown (filed herewith)

Title: UNDERWATER BATTERIES PROVIDED WITH LIQUID SEPARATING MEANS
BETWEEN INTERNAL ELECTROCHEMICAL ENVIRONMENT AND EXTERNAL LIQUID
ENVIRONMENT

PAGE 3

Attorney Dkt. No. 118.010US01

REMARKS

Applicant has rewritten claims 4-5 for certain formalities. Because the claims are amended as to form, Applicant contends that such amendments are not related to patentability of the subject matter sought to be protected. Applicant has added new claims 6-9. Applicant notes that the subject matter of new claims 6-9 derives from original claims 4-5 and thus does not constitute new matter.

CONCLUSION

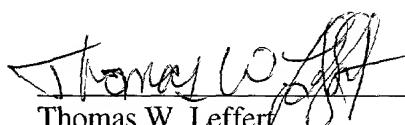
Applicant has rewritten claims 4-5 and added new claims 6-9 hereby. Claims 1-9 are now pending. Applicant respectfully requests entry and examination of all pending claims.

The Commissioner for Patents is authorized to charge any additional fees or credit overpayment to Deposit Account No. 501373.

If the Examiner has any questions or concerns regarding this application, please contact the undersigned at direct dial (612) 312-2204.

Respectfully submitted,

Date: Nov 30, 01



Thomas W. Leffert
Reg. No. 40,697

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Fogg, Slifer & Polglaze, P.A.
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Minneapolis, MN 55458-1009

T - 612/312-2200
F - 612/312-2250

VERSION WITH MARKINGS TO SHOW CHANGES MADE

4. (Once amended) The battery according to [one or more of the preceding claims]claim 1 or 2, wherein insulated and liquid-tight thorough-leads for connecting said battery to an electric load or to a battery recharger are provided.

5. (Once amended) The battery according to [one or more of the preceding claims]claim 1 or 2, wherein said elements or cell units are of the lead/sulphuric acid type.

6. (New) The battery according to claim 3, wherein insulated and liquid-tight thorough-leads for connecting said battery to an electric load or to a battery recharger are provided.

7. (New) The battery according to claim 3, wherein said elements or cell units are of the lead/sulphuric acid type.

8. (New) The battery according to claim 4, wherein said elements or cell units are of the lead/sulphuric acid type.

9. (New) The battery according to claim 6, wherein said elements or cell units are of the lead/sulphuric acid type.

UNDERWATER BATTERIES PROVIDED WITH LIQUID SEPARATING MEANS BETWEEN INTERNAL ELECTROCHEMICAL ENVIRONMENT AND EXTERNAL LIQUID ENVIRONMENT

DESCRIPTION

5 The present invention relates to batteries for underwater use provided with liquid means for separating the internal electrochemical environment and the external liquid environment therebetween.

10 Primary batteries, as well as storage batteries, can be used as power sources in underwater engineering, to operate motors, for lighting, to power-feed electrical apparatuses and the like.

15 However, at present secondary (storage) batteries, mainly of the lead/sulphuric acid type, and in some instances nickel-iron or nickel-cadmium batteries having an alkaline electrolyte, are widely used.

20 Currently available storage batteries, both the sealed and the non-sealed ones, have a recess, inside the individual cell units and above the electrolyte, containing air and the gases (hydrogen and oxygen) that can be gradually produced at the electrodes.

25 Non-sealed batteries have plugs provided with a gas vent. Both battery types, although provided with satisfactorily insulated liquid-tight clips, cannot directly be immersed at sea or lake depths, as salty, brackish or fresh water would enter the non-sealed batteries, entailing the leaking of the electrolyte, whereas sealed batteries would collapse under the external environment pressure. Both instances would entail a voltage drop and a permanent damage of the electrodes, not to mention the relevant environmental damage. Therefore, the state of the art discloses the use 30 of heavy and expensive steel casings, containing, in case of non-sealed batteries, platinum catalysts for hydrogen and oxygen recombination.

35 In light of the liquid near-incompressibility principle, the subject matter of the present invention is

- 2 -

a system that provides the filling of the recess located above the electrolyte of the cell units of a battery with a liquid meeting specific requisites.

An object of the present invention is that of providing an arrangement for liquid electrolyte batteries allowing the immersion thereof even at great depths, without the occurrence of the above-mentioned drawbacks, up to date solely avoidable by means of costly devices.

According to the present invention, an assembly 10 exploiting the near-incompressibility of the liquids and using a non-ionised liquid separating layer, non-reactive with the battery electrolyte and with the aqueous environment, is provided. The separating layer is arranged in the recess located above the electrolyte 15 solution level in the cell units of the battery, thereby allowing the assembly to be pressurised even at great depths due to the immersion, without introducing significant stresses inside the battery casing.

Other objects, features and advantages of the 20 present invention will be made apparent in the following description, given by way of example and not for limiting purposes, of several presently preferred embodiments thereof and making reference to the Figures of the annexed drawings, wherein:

25 FIG. 1 is a schematic view of a multiple-cell or element battery provided with liquid separating means (layer) according to the invention and with free apertures, at the top of the individual cell units, communicating with the external liquid environment;

30 FIG. 2 is a schematic view analogous to that of FIG. 1 and referring to a second embodiment, in which check valves are provided at the apertures at the top of the individual cells or cell units, toward the external liquid environment;

35 FIG. 3 shows a third embodiment of a battery assembly in which a manifold is provided between the vents of the individual cell units of the battery, the

-3-

manifold being provided, at the top portion thereof, with a check valve at an individual aperture communicating with the external liquid environment;

5 FIG. 4 schematically shows a further embodiment of the battery according to the present invention, in which a multiple-cell battery is housed into a container filled up with the liquid separating means (layer) and the container being provided, at the top portion thereof, with a check valve at an individual aperture communicating with the external liquid environment;

10 FIGS. 5, 6 and 7 show voltage/time charts for batteries according to the invention under a closed circuit voltage condition.

15 In light of the aforementioned, and taking into account the Figures of the annexed drawings that will hereinafter be detailed, the object of the present invention is based on the liquid near-incompressibility principle, and it provides a liquid separating layer according to the already outlined conditions.

20 The liquid separating layer performs the following tasks:

a) it allows the escape of the gases evolved within the battery towards the external environment;

25 b) it avoids short circuit current between the electrodes of different battery cells.

30 In the following disclosure the electrolyte solution of the battery will be indicated with S, a liquid floating onto the solution S will be indicated with A, the water of the external environment (sea, lake, etc.) will be indicated with E, and the densities of S, A and E will be indicated with d_S , d_A , d_E , respectively.

Three conditions underlying the present invention are:

- 35 1) The density of A must be lower than the density of S, i.e., $d_A < d_S$;
- 2) A and S must be immiscible therebetween;
- 3) A and S must be non-reactive therebetween;

-4-

When $d_A > d_E$, and always providing the requisites 1-3 are met, the check valve is superfluous and the liquids A and E can be in contact therebetween. In this instance, besides performing the tasks a) and b), the liquid A further performs the following:

c) it prevents the interdiffusion between the solution S and the water E of the external environment;

d) it allows that the internal pressure of each individual cell of the battery be equal to that of the external environment.

It is to be noted that when the batteries according to the present invention use a check valve d_A can be lower or equal to d_E ($d_A \leq d_E$).

The assembly subject matter of the present invention will hereinafter be described with reference to various embodiments thereof. FIGS. 1, 2, 3 and 4 show schematic views of such embodiments, that are to be construed as non-limiting illustrative examples of the invention itself.

FIGS. 1-3 are mere sketches, in which a highlighting of the thickness of the battery casing was omitted. Instead, the latter, as well as the thickness of the container utilised in the fourth embodiment, are highlighted in FIG. 4.

For the device of FIG. 1, in which the liquid A directly contacts the external environment water, i.e., E, a further requirement must be met, precisely:

4) The density of A must be greater than the density of E, hence, taking condition 1) into account, it must be $d_E < d_A < d_S$;

FIG. 1 schematically shows a longitudinal section of the battery according to a first embodiment thereof. Therein, a 6-cell or 6-element assembly, providing a rated voltage equal to 12 V for lead/acid batteries, is shown.

The battery comprises a casing, globally indicated with 10, partitioned into six cell units by partitions 11

extending from the bottom panel 12 of the battery to the top panel 13. Positive and negative plates 14 and 15 are housed within the six cell units, in case spaced apart by known spacers, not shown. The positive and negative plates 14, 15 are interconnected by jumpers 16, sealingly bridging the partitions 11.

The space described by the individual cell units or elements is filled up to a height h_1 with an electrolyte S. In a lead/acid battery the solution S is made of a H_2O/H_2SO_4 solution. In the traditional batteries, the electrolyte S is exposed to air which contains H_2 and is enriched with O_2 , the various gas ratios thereof being variable and depending on the operating conditions of the battery, as it is well-known to those skilled in the art.

According to the present invention, on the electrolyte S a liquid separating layer A, of a thickness h_2 , non-ionised and non-reactive with the electrolyte S or with the external liquid environment (salty, brackish or fresh water), is located.

The battery is also provided with terminals 17 and 18 for the connection to an electric load (not shown) and, if needed, to a well-known battery recharger. The terminals 17 and 18 are insulated from the external environment, e.g., with silicone or epoxy resins.

At the top portion of each cell unit, elements 19 for communicating the layer A and the external environment E therebetween, comprising an expansion chamber 20 delimited by chokes 21 and 22, are located. The communication elements 19 allow a pressure compensation of the external environment E with the internal environment of the battery S+A.

The presence of the chambers 20 and of the chokes 21 and 22 enables to prevent the external leaking of S+A in case the battery is tilted during the handling or the use.

For the embodiments indicated in FIGS. 2-4, the walls of the battery casing have to be elastic rather

than stiff, in order to adapt to the volumetric changes in the battery content, essentially due to the volumetric changes of S+A at the increase of the external environment pressure. Thus, e.g., 100 atm changes in the 5 external pressure yield volumetric changes lower than 1%, typically of 0.4-0.5%. In fact, liquids are not strictly incompressible, the compressibility value thereof depending on their nature. Hence, different liquids such as E and the S+A complex could have slightly different 10 compressibility, and also the volumetric changes due to such differences are assessable at 0.4-0.5% for pressure changes equal to 100 atm, therefore such as to easily be compensated by the elasticity of the walls of the battery casing. In fact, under such conditions, a cubic battery 15 having a 20 cm corner would undergo linear dimension changes in the order of the millimetre.

In the embodiment of FIG. 1, non-stiff walls are not required for the battery casing, since, according to the Pascal principle, the internal pressure of each 20 individual cell battery equals that of the external environment.

In the construction of the embodiment of FIG. 2, where corresponding elements are indicated with reference numbers equal to those of FIG. 1, check valves V_1, \dots, V_6 , arranged so as to allow the escape of the gases that 25 might evolve from the electrodes 14 and 15 during the battery operation, while preserving the hydrostatic balance among S, A, and E as already indicated, are provided.

30 In the construction of the embodiment of FIG. 3, in which corresponding elements are indicated with the same reference numbers of FIGS. 2 and 3, the top end of the elements 19 is connected to a manifold pipe network, globally indicated with 23, provided with branches, 24, 35 25, 26, 27, 28, 29, converging towards a common connection spot 30, at which a check valve V_K , having the same purpose of the valves V_1, \dots, V_6 of FIG. 2, is

- 7 -

arranged. As it is apparent from the drawing of FIG. 3, the arrangement of the various branchings allows the gas produced from the battery to converge to the collection vertex 30.

5 In the construction of the embodiment of FIG. 4, in which corresponding elements are indicated with the same reference numbers of FIGS. 1, 2 and 3, the casing of the battery 10 is accommodated within a watertight case 31. Said watertight case 31 is provided with a perimetric lip 10 32 registered with a corresponding perimetric lip 33 onto the bottom portion of an upwards-tapered pyramid-shaped element 34 for collecting the gases evolved at the electrodes 14 and 15 of the various cell units of the battery. At the apex of the pyramid-shaped element 34 a 15 check valve VN is located. At the lips 32 and 33, fastened therebetween with bolts 36, a seal 35 is located.

20 Within the element 34, seal feedthroughs 37 and 38 for the passage of connection cables to the terminals 17 and 18 of the battery are provided. The entire space around and above the battery casing 10, as well as the space over the electrolyte S is filled up with the 25 separating liquid A, having the already described characteristics and that will hereinafter be better detailed.

Further, it has to be pointed out that the battery housed within the case 31 as shown in FIG. 4 could be replaced by a number of batteries.

30 The characteristics and the nature of the liquid forming the separating layer A (liquid separating means) between the electrolyte S and the external environment E will hereinafter be disclosed. As above-disclosed, the liquid A must be non-ionised in order to be insulating.

35 It has to be pointed out that the density of the electrolyte solution of a lead/sulphuric acid battery depends on the battery type and charge. Thus, e.g., the electrolyte density in an electric car battery during the

- 8 -

discharge ranges from 1.33 to 1.21 g/ml, whereas in a battery for stationary plants the density ranges from 1.225 to 1.08 g/ml. In a nickel-iron battery with an alkaline electrolyte (20-30% KOH, 50 g/l LiOH) the density usually exceeds 1.16 g/ml. Therefore, considering that the seawater density is usually lower than 1.025 g/ml, it can be stated that a separating liquid A having a density ranging from 1.04 to 1.07 g/ml, immiscible with aqueous solutions and non-reactive in an acidic or alkaline environment, proves to be an all-purpose separating liquid for storage batteries with an acidic or alkaline electrolyte, to be used according to the embodiment sketched in FIG. 1. However, for any acidic or alkaline electrolyte battery to be used according to the embodiment of FIG. 1, a liquid A, immiscible and non reactive with the electrolyte solution, having a density smaller than the minimum density evidenced by said solution during the discharge process, yet greater than that of the external environment water, can always be found.

Substances useful as separating liquid A, covering the electrolyte solution, in the embodiment of FIG. 1 can be selected also from the following substance classes:

chlorinated hydrocarbons, like, e.g., 1,1,1-trichloroethane, chlorobenzene, 1,1,2,2-tetrachloroethane, 1,2-dichlorobenzene, carbon tetrachloride, trichloroethylene, 2-chlorotoluene, 4-chlorotoluene;

bromidated hydrocarbons, like, e.g., 1-bromodecane, bromobenzene, 1-bromoethane, bromocyclohexane;

nitroderivatives of hydrocarbons, like, e.g., nitrobenzene;

silicones, like, e.g., the silicone oil 710. These substances can be utilised as such or as mixtures thereof, or even admixed to hydrocarbons. Even solid substances belonging to the first three substance classes like, e.g., solid 1,4-dichlorobenzene, could be dissolved

in other liquid substances of the same class or in hydrocarbons. The solution having the required density can easily be obtained carrying out the admixture of the various substances in presence of a densimeter.

5 In the embodiments shown in FIGS. 2-4, check valves are provided, preventing the external environment water from entering the battery, as a covering liquid A, besides the substances belonging to the above-mentioned groups, immiscible and non-reactive liquids, the density 10 of which being lower than that of the external environment water, like, e.g., a hydrocarbon mixture like oil, naphtha, kerosene, Nujol or liquid paraffin, (with a density being generally comprised in the range 0.76-0.88 g/ml) or their mixtures can suitably be utilised.

15 The discharge curves, i.e. the CCV (closed circuit voltage) versus time, of some batteries available on the market modified according to the present invention are shown in FIGS. 5-7. FIG. 5 shows the discharge of a 12V/35Ah lead/sulphuric acid battery, connected to a 20 water-cooled 0.33 ohm/300 W load resistor, the electrolyte solution thereof having been covered according to the embodiment of FIG. 1 with a liquid mixture of several substances belonging to the afore-mentioned groups, by way of demonstration of the 25 compatibility of said substances with the electrolyte.

FIG. 6 shows the discharge of a 1.3V/5Ah nickel-iron battery connected to a 1.74 ohm/4 W load resistor, whereas FIG. 7 shows the discharge of a cadmium-nickel battery, made of seven 1.2V/3Ah cell units, connected to a 30 12 ohm/20 W load resistor. Both batteries were of the alkaline electrolyte type, and were filled with liquid paraffin according to the embodiments of FIGS. 2 and 4, respectively.

35 All the above-mentioned curves were obtained with the batteries immersed at a 50 m depth in sea water. Identical discharge curves were obtained for the in-air discharge of the same batteries with the same load

- 10 -

resistors.

- 11 -

CLAIMS

1. A lead acid battery for underwater use comprising a plurality of series connected elements contained in a casing, each element having a positive electrode and 5 a negative electrode in a liquid electrolyte, each element being provided with an aperture communicating with the external environment,

10 liquid separating means provided in contact with the electrolyte, consisting of a liquid that is non-ionised, insoluble and non-reactive both in respect of said electrolyte and of the external liquid environment made of fresh or salty water

15 characterised by the fact that said liquid separating means belong to the class formed by 1-bromodecane, silicone oil with density equivalent to Dow Corning DC 710 and their admixtures.

2. The battery according to claim 1, wherein said elements are made of cell units.

20 3. The battery according to claim 1 or 2, wherein each element or cell unit is provided with an individual communication element comprising an expansion chamber delimited by chokes.

25 4. The battery according to one or more of the preceding claims, wherein insulated and liquid-tight thorough-leads for connecting said battery to an electric load or to a battery recharger are provided.

5. The battery according to one or more of the preceding claims, wherein said elements or cell units are of the lead/sulphuric acid type.

30

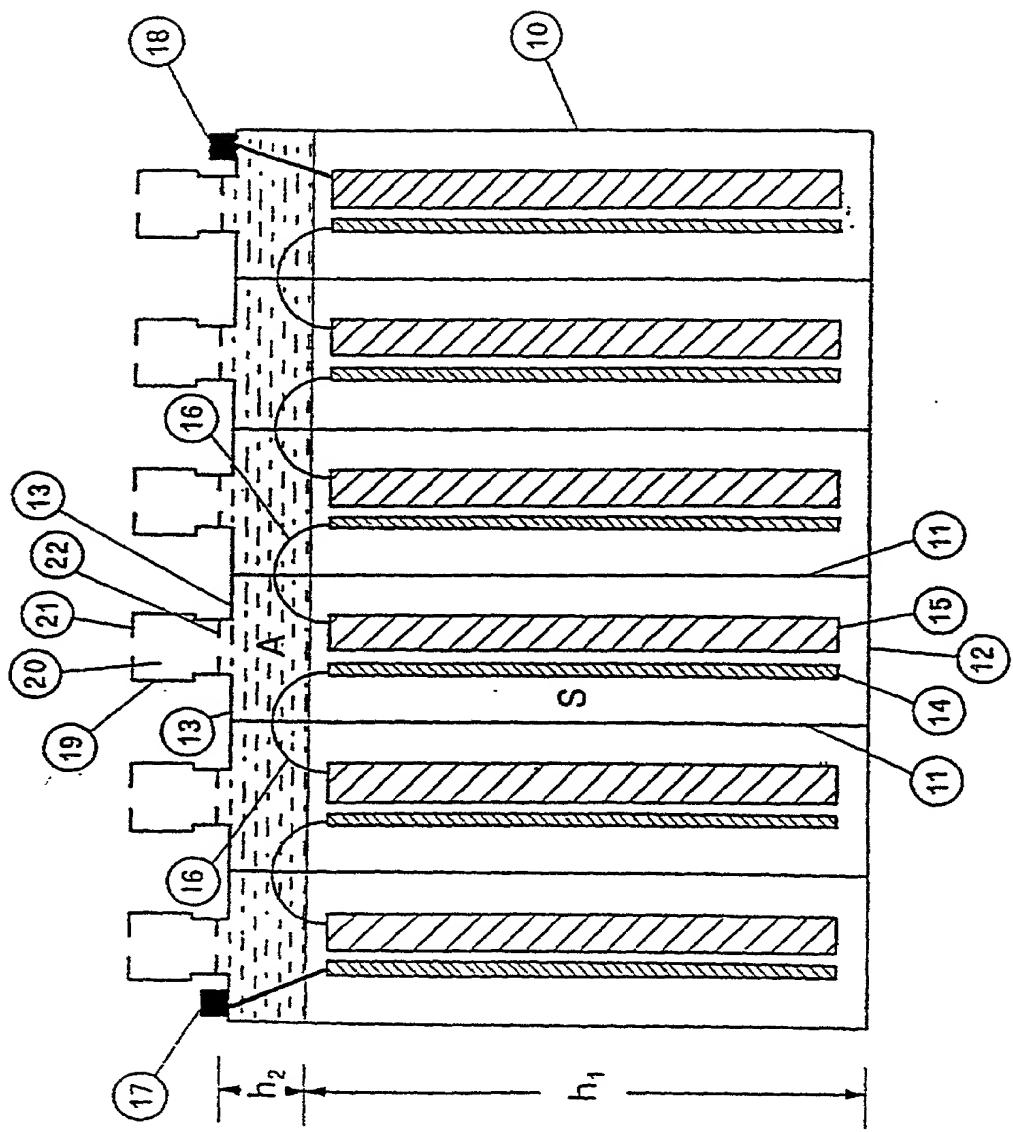


FIG. 1

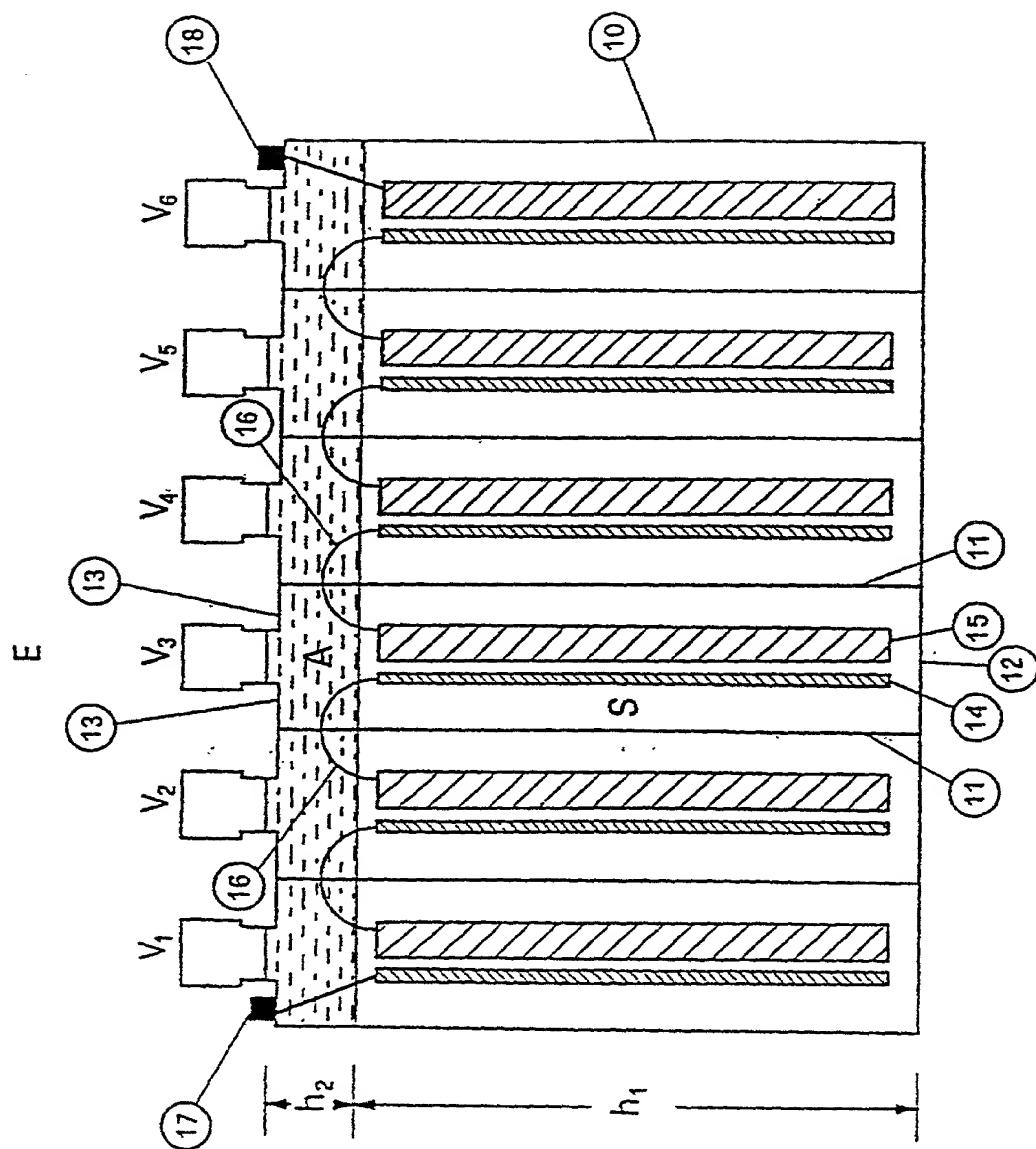
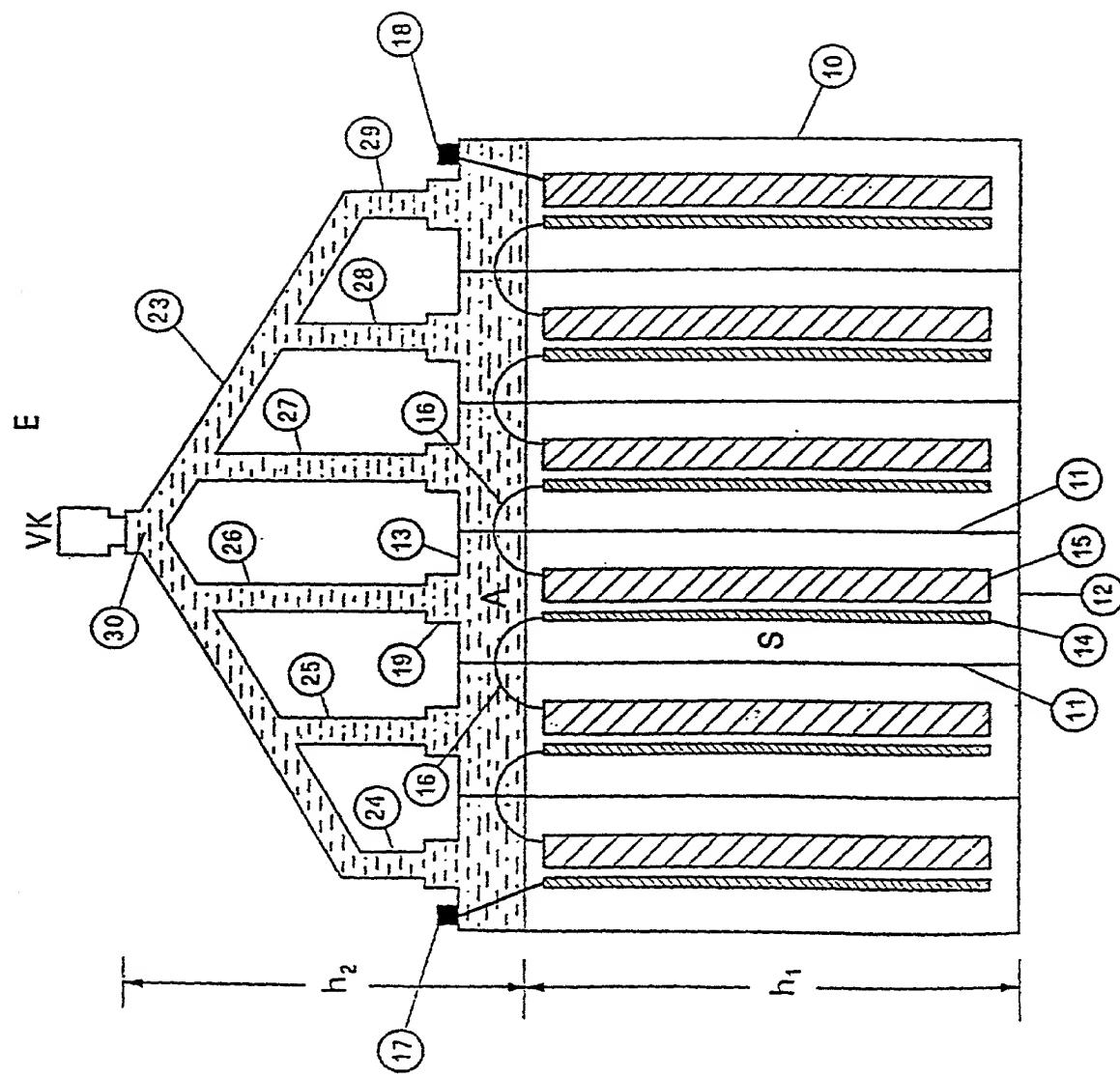


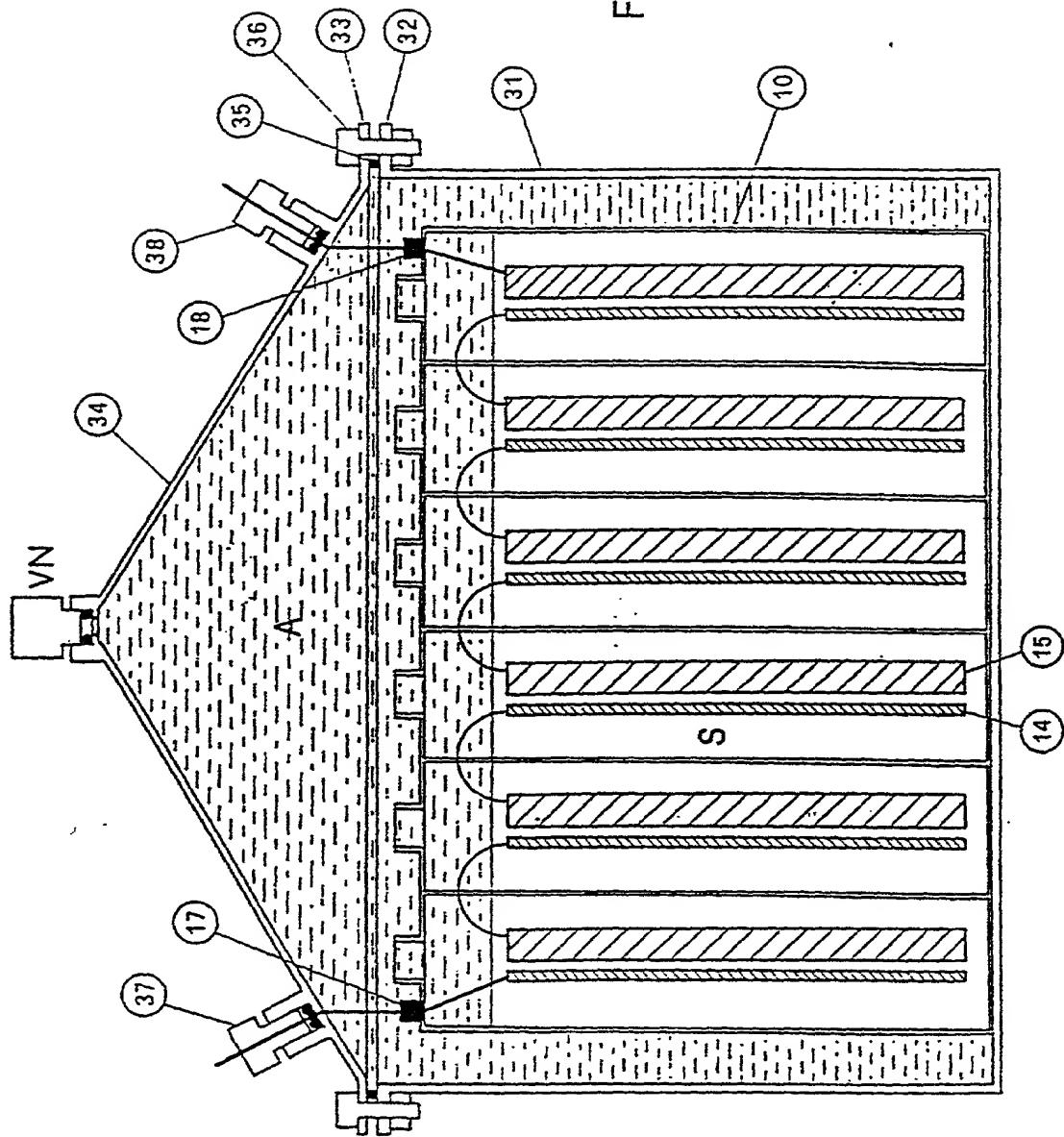
FIG. 2

FIG. 3



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FIG. 4



- 5/7 -

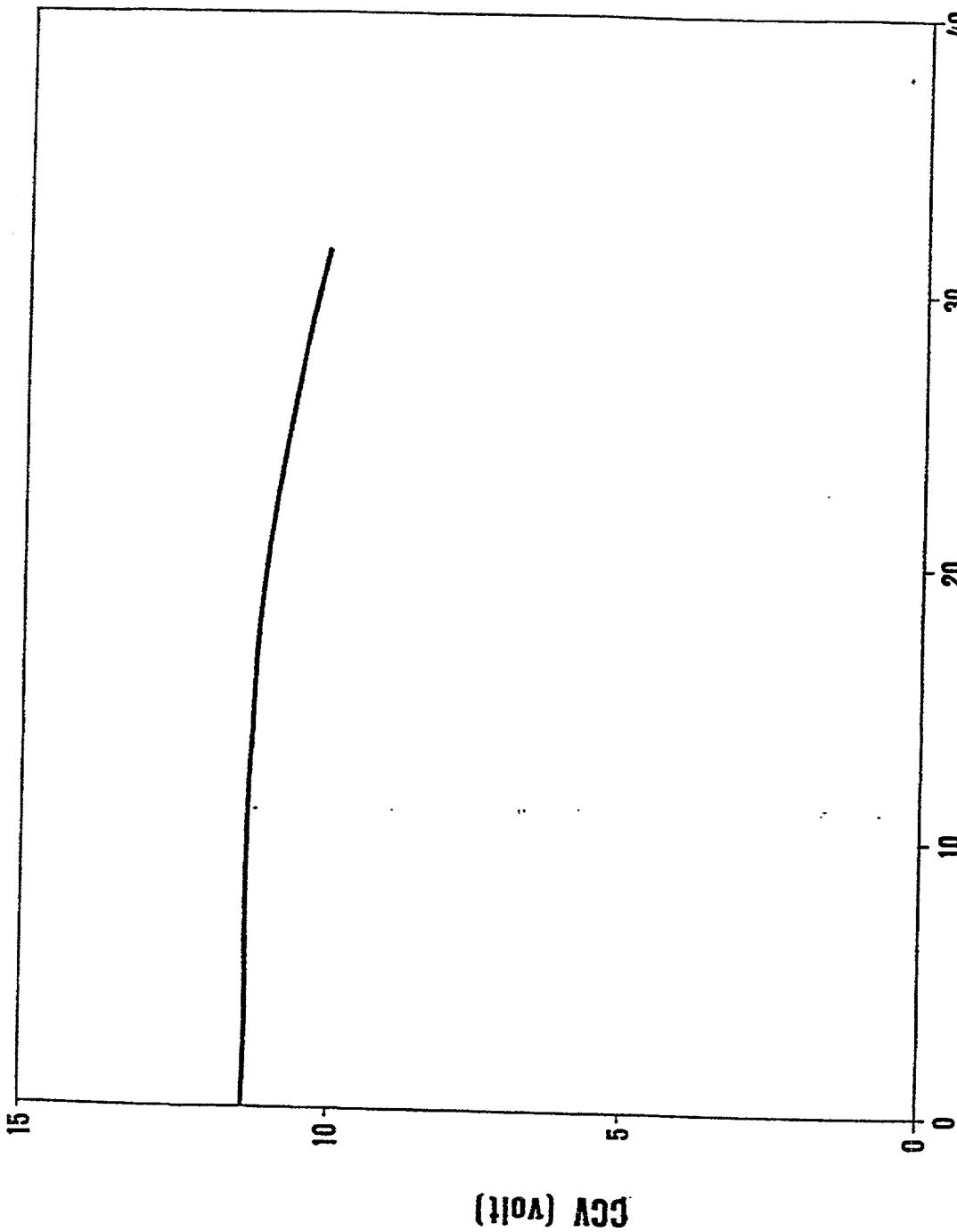


FIG.5

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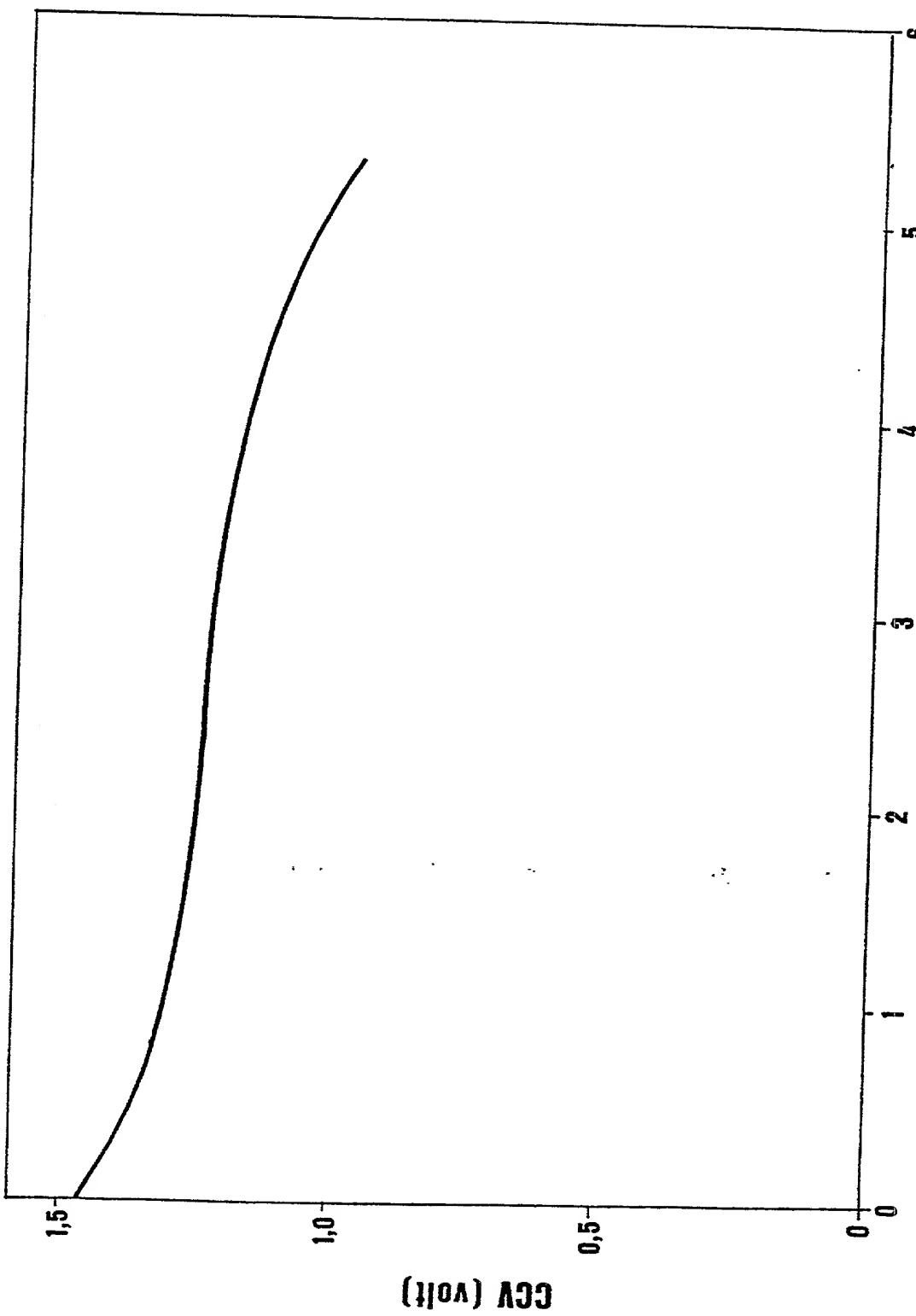


FIG.6

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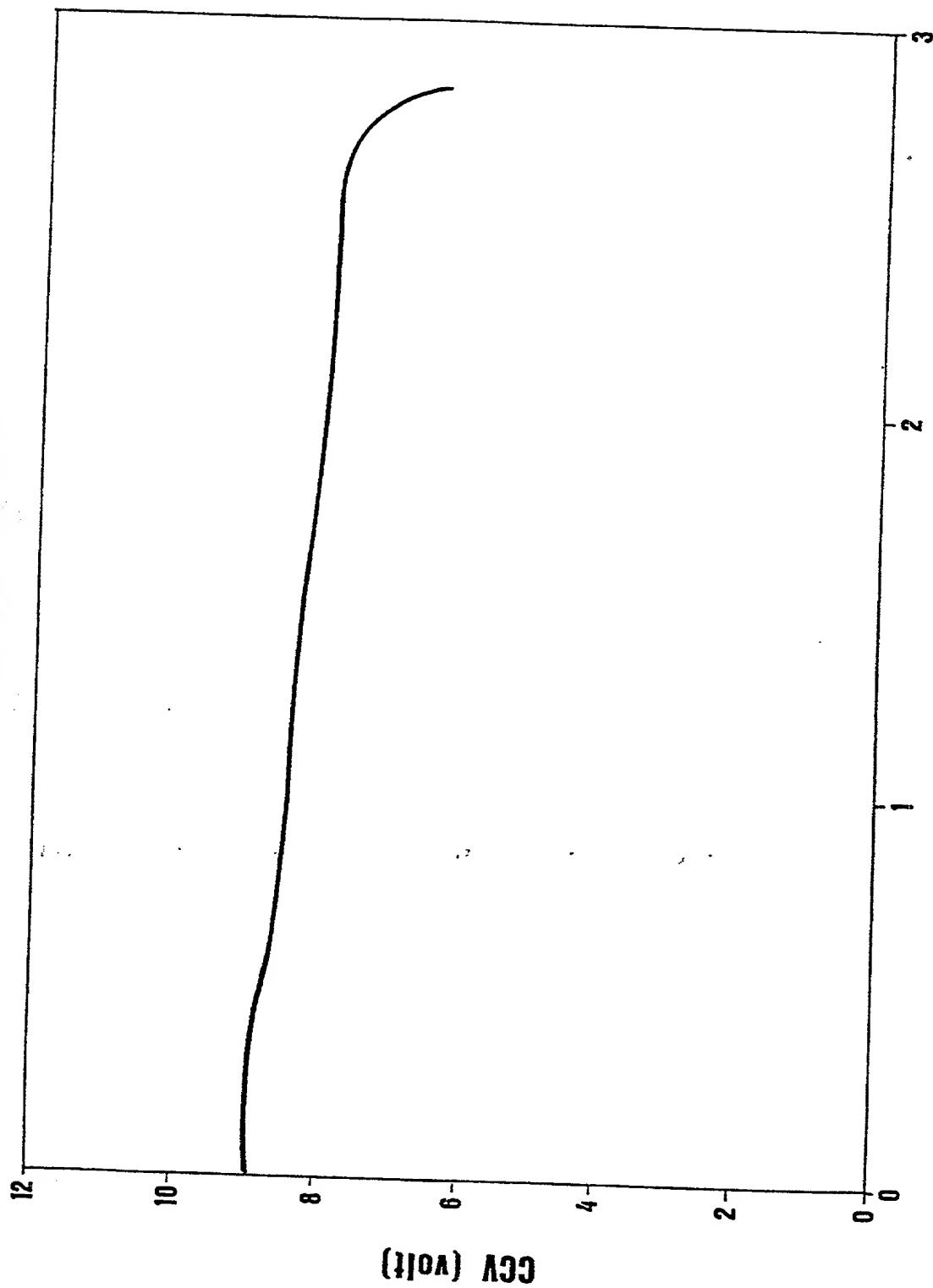


FIG.7

United States Patent Application

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original and first inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled: **UNDERWATER BATTERIES PROVIDED WITH LIQUID SEPARATING MEANS BETWEEN INTERNAL ELECTROCHEMICAL ENVIRONMENT AND EXTERNAL LIQUID ENVIRONMENT** the specification of which was filed on November 30, 2001, and which has received U. S. Patent Serial Number 09/980,267.

I have reviewed and understand the contents of the above-identified specification, including the claims.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. § 1.56 (see attached page).

I claim foreign priority benefits under 35 U. S.C. § 119/365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on the basis of which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached
RM99A000355	Italy	06/03/1999		

I claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)

I claim the benefit under 35 U.S.C. § 120/365 of any United States and PCT international application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose material information as defined in Title 37 C.F.R. § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. or PCT Application Number	Filing Date (MM/DD/YYYY)	Patent No.
PCT/IT00/00229	06/05/2000	

As a named inventor, I appoint the following registered practitioners to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith, with full right of substitution:

Name	Registration Number	Name	Registration Number
Fogg, David N.	Reg. No. 35,138	Polglaze, Daniel J.	Reg. No. 39,801
Leffert, Thomas W.	Reg. No. 40,697	Ryan, Laura A.	Reg. No. 49,055
Lundberg, Scott V.	Reg. No. 41,958	Slifer, Russell D.	Reg. No. 39,838
Kelly, Mark D.	Reg. No. 39,467	Walseth, Andrew C.	Reg. No. 43,234
Myrum, Tod A.	Reg. No. 42,922		

Please direct all correspondence in this case to:

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§ 1.56 Duty to disclose information material to patentability.

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is canceled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is canceled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

- (1) prior art cited in search reports of a foreign patent office in a counterpart application, and
- (2) the closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and

- (1) it establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or
- (2) it refutes, or is inconsistent with, a position the applicant takes in:
 - (i) opposing an argument of unpatentability relied on by the Office, or
 - (ii) asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

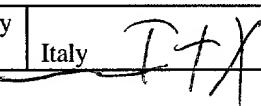
(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

- (1) Each inventor named in the application;
- (2) Each attorney or agent who prepares or prosecutes the application; and
- (3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

(e) In any continuation-in-part application, the duty under this section includes the duty to disclose to the Office all information known to the person to be material to patentability, as defined in paragraph (b) of this section, which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Inventor							
Given Name (First and Middle [if any])		Family Name or Surname					
Fernando		<u>ZOCCHI</u>					
Inventor's Signature					Date 1st March 2002		
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0990267-027202

Combined Declaration and Power of Attorney

Filed: November 30, 2001

Title: UNDERWATER BATTERIES PROVIDED WITH LIQUID SEPARATING MEANS BETWEEN INTERNAL
ELECTROCHEMICAL ENVIRONMENT AND EXTERNAL LIQUID ENVIRONMENT

Attorney Docket No. 118.010US01

S/N: 09/980,267

Page 2 of 3